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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/698,179	10/30/2003	Thomas W. Kenny	COOL-01302	2504
28960	7590	06/11/2009	EXAMINER	
HAVERSTOCK & OWENS LLP 162 N WOLFE ROAD SUNNYVALE, CA 94086				FORD, JOHN K
ART UNIT		PAPER NUMBER		
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/698,179	KENNY ET AL.	
	Examiner	Art Unit	
	John K. Ford	3744	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 01 June 2009 and 07 May 2009.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1,8-27,29-33 and 35-128 is/are pending in the application.
- 4a) Of the above claim(s) 9,11,15,18,20-27,33,35-37,39,42,43 and 45-127 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1,8,10,12-14,16,17,19,29-32,38,40,41,44 and 128 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>07 May 2009</u> . | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| | 6) <input type="checkbox"/> Other: _____ |

Applicant's response of June 1, 2009 has been studied carefully.

Applicant has elected (now shown in Figure 21) a species of Figures 3A-3B, wherein, instead of microchannel walls 110 as shown in Figure 3B, applicant now has, in Figure 21, replaced those microchannel walls 110, with a porous structure 110' that can be one of sintered metal or silicon foam. Among these two alternatives of material, applicant elected sintered metal.

An action on the merits follows on claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29-32, 38, 40, 41, 44 and 128. The remainder of the claims are designated as non-elected or have been canceled.

Applicant's amendments have overcome the 35 USC 112, second paragraph, rejections set forth in the previous office action. As the examiner understands it, claim 1 is directed to the heat exchanger, per se, while claim 128 is directed to the heat exchanger of claim 1 in combination with a heat source including "at least one interface hot spot region".

Applicant's remarks with respect to the allowability of the claims however are not convincing and they are addressed in the rejections that follow. The prior office action is essentially repeated below with annotations addressing applicant's most recent remarks and making a clerical change for the fact that the subject matter of claim 128

(which was previously part of claim 1) is now recited in a dependent claim that depends from claim 1.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40 and 128 are rejected under 35 U.S.C. 103(a) as obvious over the combined teachings of Gruber et al (USP 5,388,635) and Anderson et al (USP 5,761,037).

Gruber, assigned to IBM, shows in Figures 3 and 4 a system for cooling a heat source. A structure 20 defines an inlet port 28 that channels fluid to fingers 30 that branch out in a plurality of directions from the inlet port. These fingers feed fluid to at least one intermediate plate 18 or 16 that has a plurality of holes extending therethrough. A heat exchanger layer 14 includes micro-fins 56 defining micro-grooves 58 between them similar to applicant's Figure 3A-3B species. As explained by Gruber, the heat exchanger layer 14 can also be "fin-less". See col. 8, line 34-43, incorporated here by reference. If the heat exchanger layer 14 is "fin-less" Gruber states that it may

have “a texture or structures to promote fluid stirring and heat transfer”. Gruber discusses hot spots in col. 15, lines 1-41, incorporated here by reference.

Anderson, also assigned to IBM, shows a heat source 30 (an integrated circuit “chip”) contacting a conducting portion 104 of a heat exchanger. A heat exchanging layer 103 of sintered copper (a microporous sintered metal according to applicant’s own examples in his own disclosure) is shown and may be bonded to conducting portion 104. An inlet port connected to pipe 21 and an outlet port connected to pipe 11 are shown in Figure 4. While no particular region in Anderson’s integrated circuit chip is disclosed as being hotter than another, arguably applicant’s claim doesn’t even claim an integrated circuit chip so the limitation is not given weight absent a claim to the overall combination. Notwithstanding that fact, it is apparent that the “hot spot region” 104 is cooled far more in the center than right at the edge because of the geometry of the device.

To have combined the teachings of Gruber and Anderson by attaching Anderson’s wicking layer 103 to Gruber’s heat exchanger “fin-less” layer 14 to promote heat transfer particularly when evaporating fluids would have been obvious to one of ordinary skill in the art. Alternatively, to have used Gruber’s fluid distribution system (i.e. everything above sheet 14 in Gruber) in place of the fluid distribution system of Anderson (i.e. everything to the left of sheet 103 in Figures 1 and 2 of Anderson) would

have been obvious to one of ordinary skill in the art to advantageously achieve high flows with low pressure drop (a benefit explicitly stated by Gruber).

Regarding claim 10, see the outlet in Figure 4 of Anderson, connected to pipe 11. Also see outlet 46 in Gruber. Regarding claims 12 and 13 fluid inlet and outlet grooves are shown in Gruber. Claim 14, being a method of use limitation in an apparatus claim, is not a limitation on the apparatus itself (for further explanation, see MPEP 2114, incorporated here by reference). Regarding claim 17 there is no overhang shown between the layers in Gruber. Since there is no overhang and applicant's claimed range includes an overhang of "0" (i.e. zero) millimeters, this limitation is met.

Regarding claim 32, every porous material by the nature of its formation is formed with irregular pores that inherently vary randomly over the flow path as a consequence of their random orientation. Regarding claims 38 and 40, see Figure 4 of Anderson wherein the body is at least thermally coupled to the integrated circuit chip.

On page 17 of the response of June 1, 2009, counsel contends that the fingers (which the examiner has identified as channels 30 and are clearly shown in Figure 2 and Figure 3 of Gruber as radiating out from inlet 28 in a plurality of different directions before eventually becoming parallel) of Gruber do not branch out in a plurality of directions (citing the language in col. 5, lines 42-44 of Gruber in support of this contention). The language in col. 5, lines 42-44 is in the "**Summary of the Invention**" section of the Gruber specification. Summaries by their nature are inherently broad

overviews of the invention and typically do not include the details found in the detailed portion of the disclosure including the drawings. Figure 2 of Gruber (which appears to be schematic in nature) shows the two fingers 30 initially radiating from inlet 28 in two completely opposite directions (180 degrees of arc from one another) before turning to become parallel and then splitting again in two opposite directions to form conduits 32 (which could also be viewed as fingers or portions of fingers) which again eventually become parallel. These fingers 30 (and 32) of Gruber definitely meet the limitation in claim 1 that the “fingers [which] branch out in a plurality of directions from the at least one inlet port.....” Similarly, more structural depictions of fingers 30 in Figures 3, 8B and 22 of Gruber all show the fingers 30 radiating out from the inlet port 28 in different directions before eventually turning parallel and then extending in different directions yet again in portions 32.

Turning for a moment to applicant's own disclosure, applicant's own fingers 118 and 120 have portions that are parallel to one another very similar to the parallel portions shown in Gruber. Likewise, fingers 118 and 120 of applicant's disclosure have portions that are not parallel to one another very similar to the non-parallel portions shown in Gruber. It is apparent that counsel's argument in favor of patentability must fail because the fingers of Gruber and applicant's own disclosed fingers have portions that extend in different directions and other portions that do not.

The argument that Anderson does not have fingers branching out in different directions is similarly unavailing because Anderson was not relied upon to teach this feature.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40 and 128 are rejected under 35 U.S.C. 103(a) as obvious over the combined teachings of Gruber/Anderson as applied to claims 1, 8, 10, 12, 13, 14, 17, 19, 32, 38, 40 and 128 above and further in view of either Hou (USP 5,983,997) or Messina et al (USP 5,239,200).

Hou teaches forming different flow channel structures to provide different cooling rates to different parts of the heat transfer surface. Messina teaches the same thing in regard to the explanation of Figure 5, incorporated here by reference. In view of either of these teachings it would have been obvious to have structured the passageways and flow rates in Gruber/Anderson to concentrate cooling in certain areas of high heat load.

In response to applicant's June 1, 2009 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port of Gruber is incorporated here by reference.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber/Anderson alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Herrell (USP 4,758,926).

The thickness of layer 104 is not disclosed in Anderson. Gruber discloses a thickness of 375 micrometers (col. 12, line 59) which is 0.375 mm (within applicant's range of 0.3 to 0.7mm).

In Herrell layer 40 is 25 mils thick. Each mil is 25.4 microns. Layer 40 is therefore 635 microns thick. 635 microns is 0.635 millimeters, within applicant's claimed range. To have made the layer 104 of Anderson .635 millimeters thick (when used with Gruber's fluid distribution system) as taught by Herrell would have been obvious since it is shown by Herrell to be a dimension that works. Similarly to have made the same layer 0.375 mm as taught by Gruber because it also works would have been obvious to one of ordinary skill in the art.

In response to applicant's June 1, 2009 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port of Gruber is incorporated here by reference.

Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber/Anderson alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Tonkovich (USP 6,680,044).

As disclosed the porosity of the porous microstructure should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of Anderson with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63, incorporated here by reference (teaching a porosity within applicant's claimed range as well as pore sizes in applicant's claimed range and a channel height with applicant's claimed range), would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients.

In response to applicant's June 1, 2009 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port of Gruber is incorporated here by reference.

Claims 1, 8, 10, 12, 13, 14, 17, 19, 29, 30, 31, 32, 38, 40 and 128 are rejected under 35 U.S.C. 103(a) as obvious over Gruber et al (USP 5,388,635) in view of the Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers".

Gruber, assigned to IBM, shows in Figures 3 and 4 a system for cooling a heat source. A structure 20 defines an inlet port 28 that channels fluid to fingers 30 that branch out in a plurality of directions from the inlet port. These fingers feed fluid to at least one intermediate plate 18 or 16 that has a plurality of holes extending therethrough. A heat exchanger layer 14 includes micro-fins 56 defining micro-grooves 58 between them similar to applicant's Figure 3A-3B species. As explained by Gruber, the heat exchanger layer 14 can also be "fin-less". See col. 8, line 34-43, incorporated here by reference. If the heat exchanger layer 14 is "fin-less" Gruber states that it may have "a texture or structures to promote fluid stirring and heat transfer".

The Jiang article discloses the art recognized equivalence of microchannel structures 56 and 58 of Gruber and porous microstructures as claimed by applicant currently. To have made the microchannel structures 56 and 58 of Gruber of microporous media as taught by the Jaing article would have been obvious to one of ordinary skill in the art. In general the microporous media is advantageous in terms of having better heat transfer than the microchannel structures 56 and 58 of Gruber as would have been obvious to have used for that reason in spite of their somewhat higher pressure drop.

Regarding claim 8, the inlet port 28 and outlet port 46 are parallel to a plane. Regarding claim 13, grooves (i.e. long narrow channels) are shown in Gruber channeling fluid from one of the inlet and outlet to the fingers. Claim 14, is satisfied

because Gruber does not disclose any boiling or vaporization of the heat exchange fluid. Alternatively claim 14, being a method of use limitation in an apparatus claim is not a limitation on the apparatus itself (for further explanation, see MPEP 2114, incorporated here by reference). Regarding claim 17, in Gruber there is no overhang shown in Figures 13-15. Since there is no overhang and applicant's claimed range includes an overhang of "0" (i.e. zero) millimeters, this limitation is met by Gruber. Regarding claim 19, while the preferred material of manufacture in Gruber is metal and the metals listed in column 13, lines 3-14 have a higher conductivity than silicon, which is approximately 120 W/mK and can be looked up in standard handbooks, so claim 19 is met by Gruber. Metals, such as copper explicitly disclosed in Gruber has an extremely high conductivity.

In response to applicant's June 1, 2009 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port of Gruber is incorporated here by reference.

Claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29, 30, 31, 32, 38, 40 and 128 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gruber in view of O'Neill et al (USP 4,896,719) and Tonkovich (USP 6,680,044).

Gruber, assigned to IBM, shows in Figures 3 and 4 a system for cooling a heat source. A structure 20 defines an inlet port 28 that channels fluid to fingers 30 that

branch out in a plurality of directions from the inlet port. These fingers feed fluid to at least one intermediate plate¹⁸ or 16 that has a plurality of holes extending therethrough. A heat exchanger layer 14 includes micro-fins 56 defining micro-grooves 58 between them similar to applicant's Figure 3A-3B species. As explained by Gruber, the heat exchanger layer 14 can also be "fin-less". See col. 8, line 34-43, incorporated here by reference. If the heat exchanger layer 14 is "fin-less" Gruber states that it may have "a texture or structures to promote fluid stirring and heat transfer".

To have replaced the microchannel layer 14 of Gruber with the corresponding porous layer construction of O'Neill (i.e. skin 15 and adjoining expanded foam 25) would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients as would occur when there were discrete heat transfer zones as is the case in Gruber. Note that porous microstructures have better heat transfer characteristics than microchannels as evidenced by Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers." Here the Jaing article is only relied upon to show an inherent property of porous microstructures compared to microchannels.

As disclosed the porosity of the expanded foam should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being

claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of Gruber/O'Neill with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63, incorporated here by reference, would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients as would occur when there were discrete heat transfer zones as is the case in Gruber.

In response to applicant's June 1, 2009 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port of Gruber is incorporated here by reference.

Claims 41 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of the prior art references as applied to claim 1 above, and further in view of Cardella (USP 5,918,469) or WO 01/25711 A1 (cited by applicant).

Cardella teaches a thermoelectric cooler 24 between a heat source (an integrated circuit chip 22) and a liquid-coolant type heat exchanger 20. To have inserted a thermoelectric cooler between each of the integrated circuits of Gruber (in combination with the other prior art discussed above) and the bottom layer of Gruber (in combination with the other prior art discussed above) to advantageously cool the integrated circuits even more would have been obvious to one of ordinary skill in the art in view of Cardella. Alternatively, to have replaced heat exchanger 20 of Cardella with

the microchannel heat sink assembly described in the above rejections to advantageously improve cooling in Cardella would have been obvious to one of ordinary skill in the art.

Finally, to have replaced either or both of the heat sink assemblies of WO 01/25711 A1 (cited by applicant) best seen in Figure 2 (18 and 19 at the bottom and 15 and 16 at the top) with the heat sink assembly of Gruber (in combination with the other prior art discussed above) would have been obvious to one of ordinary skill in the art to improve the cooling performance by advantageously reducing the length of the fluid flow paths.

In response to applicant's June 1, 2009 remarks, the examiner's explanation, above, of how the fingers of Gruber branch out in a plurality of directions from the at least one inlet port of Gruber is incorporated here by reference.

Finality of this office action:

In addition this action is made final pursuant to the guidance provided in the MPEP: 706.07(b) [R-6] Final Rejection, When Proper on First Action (reproduced below):

The claims of a new application may be finally rejected in the first Office action in those situations where (A) the new application is a continuing application of, or a substitute for, an earlier application, and (B) all claims of the new application (1) are drawn to the same invention claimed in the earlier application, and (2) would have been properly finally rejected on the grounds and art of record in the next Office action if they had been entered in the earlier application.

> The claims of an application for which a request for continued examination (RCE) has been filed may be finally rejected in the action immediately subsequent to the filing of the RCE (with a submission and fee under 37 CFR 1.114) where all the claims in the application after the entry of the submission under 37 CFR 1.114 (A) are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114, and (B) would have been properly finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to the filing of the RCE under 37 CFR 1.114.<

A first Office action in a continuing or substitute application >or an RCE< may not be made final if it contains a new ground of rejection necessitated by the amendments to 35 U.S.C. 102(e) by the Intellectual Property and High Technology Technical Amendments of 2002 (Pub. L. 107-273, 116 Stat. 1758 (2002)).

However, it would not be proper to make final a first Office action in a continuing or substitute application >or an RCE< where that application contains material which was presented in the earlier application after final rejection or closing of prosecution but

was denied entry because (A) new issues were raised that required further consideration and/or search, or (B) the issue of new matter was raised.

Further, it would not be proper to make final a first Office action in a continuation-in-part application where any claim includes subject matter not present in the earlier application.

Because none of the “would not be proper to make final” exceptions enumerated in the above Rule apply in this case, this office action is properly made final.

All claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John K. Ford whose telephone number is 571-272-4911. The examiner can normally be reached on Mon.-Fri. 9-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cheryl Tyler can be reached on 571-272-4834. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/John K. Ford/
Primary Examiner, Art Unit 3744